

January 12, 2011

Dr. Richard Norgaard, Chair  
Delta Independent Science Board  
980 Ninth Street, Suite 1500  
Sacramento CA 95814

Re: Introductory statement on multiple stressors

Dear Dr. Norgaard:

Thank you for this opportunity to provide brief comments on my perspective working with fish management and multiple stressors and their relative importance in the Bay-Delta ecosystem. I wish I could have attended the January 12 workshop in person, but had previously scheduled field work prior to your invitation.

### **Observations**

The Delta Regional Ecosystem Restoration and Implementation Program (DRERIP) developed objective criteria for evaluating drivers of species' transition probabilities between life stages. Evaluating the magnitude of a stressor on a species requires objective criteria for evaluating the importance, understanding, and predictability of the stressor. While the desire to complete this step is often diminished due to the time and effort required for developing criteria scores, it is the critical step that leads to explicit explanations of the magnitude of a stressor, reduces subjectivity by the evaluator, and assists in identifying information gaps. In writing the green and white sturgeon DRERIP conceptual models, I found the focus of DRERIP on developing conceptual life cycle models to evaluate the transitions between species' life stages to be the right scale for considering abiotic and biotic stressors. This is because these models required the mechanism by which stressors interact with the population to be identified, provided a holistic consideration of all stressors through all life stages, and integrated stressors in all ecosystems aquatic species may pass through (i.e. estuarine, riverine, marine). The methods for this framework of stressor evaluation are well developed for key ecosystem communities, processes, and species in the Bay-Delta; the conceptual models have gone through agency and anonymous peer review; and these have been used in various regional planning processes.

The Green sturgeon Recovery Team is beginning to evaluate multiple stressors impacting the species across its range. Attempts are being made to merge various conservation tools like the Conservation Action Planning methodology (TNC 2006) and/or MIRADI (<https://miradi.org/>). I

have not used these tools, but am interested in seeing how well these approaches can be used to evaluate multiple stressors. From reviewing these tools, I am concerned that they may lack the critical step of identifying the mechanism by which a stressor is affecting a species' life stage, and they seem to focus primarily at the natural community and ecosystem process scales. However, these approaches go further than simply defining goals for stewardship strategies and articulating threats to attaining these conservation targets, and a major benefit of a tool like MIRADI may be that its many layers allow relationships to be developed between targets, conservation actions, stressors, monitoring indicators, workplans, and budgets. Although these models are well developed and there seems to be a broad group of practitioners, these frameworks have not been applied to evaluating multiple stressors or strategizing how to reduce their impact in the Bay-Delta. While these tools have promise and seem amenable to landscapes and communities scales their approaches may make them difficult to apply at the population scale.

### **Opportunities**

I believe the tools described above can actually complement each other to guide an objective evaluation of multiple stressors and develop a program (i.e. conservation strategy, monitoring program, action plan, and budgets) to reduce the impacts of multiple stressors. One opportunity could be taking the DRERIP models, which focus on mechanisms affecting transitions between life stages, and developing them into quantitative life cycle models to further advance evaluating scenarios which alter the magnitude of stressors on life stage transitions. While managers inherently acknowledge their actions influence on abiotic and biotic stressors, Bay-Delta planning has lacked including a conceptual model of societal actions and how these influence stressors. This approach appeared essential to multiple stressor evaluation and ecosystem management in South Florida (Gentile et al. 2001) and had utility in considering anthropogenic drivers in Prince Williams Sound (Harwell et al. 2010). A Bay-Delta societal conceptual model should be developed based on review of DRERIP models with a focus of linking anthropogenic drivers with abiotic and biotic stressors influencing species' transitions between life stages. As this approach advances, managers will gain insight into which stressors are most significant in the Bay-Delta for key species, identify which stressors require additional information to adequately determine their impact, characterize the mechanisms for addressing water supply and ecosystem function in the Delta, and further develop the programmatic tools necessary to develop a management plan for the Bay-Delta.

Best regards,

Joshua Israel  
jaisrael@usbr.gov

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Harwell, M.A., J.H. Gentile, K.W. Cummins, R.C. Highsmith, R. Hilborn, P. McRoy, J. Parrish, T. Weingartner. 2010. A Conceptual Model of Natural and Anthropogenic Drivers and Their Influence on the Prince William Sound, Alaska, Ecosystem. *Human and Ecological Risk Assessment: An International Journal*, 16: 4, 672 — 726

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